ducts and the absence of filling of the smaller channels with marked improvement following repeated irrigations with warm salt solution. Here again the flushing of these channels with a dilute bile should be helpful.

A similar situation may follow primary acute liver injuries, and when given at the proper time during convalescence, decholin has been shown to be of great assistance in speeding the recovery. In both types of liver injuries, the primary form and that following duct obstruction, there must come an optimal time also when a change from the protective carbohydrate diet to the stimulating meat diet should be definitely useful. Certainly the change should not be made while the usual liver function tests remain positive nor until the van den Bergh reaction approaches the normal level.

The condition of pregnancy bears the reputation of being a predisposing factor in the development of gall-stones. The question arises, what may be done here in the way of prophylaxis? Apparently this possibly important and practical problem has not received the attention that it deserves. It is known that mild disturbances of liver function occur not infrequently in the latter half of pregnancy. Westphal believes that the tone of the sphincter of Oddi is increased in pregnancy. Other observers report that the gall-bladder of the pregnant woman contracts earlier and more quickly after a subcutaneous injection of pituitrin than that of the nonpregnant woman. There are reports of normal gall-bladder evacuation in pregnant women, and other reports emphasizing the difficulty of obtaining normal shadows attributing most of the variations from normal to technical roentgenologic difficulties. Ivy and Bergh state that the prevention of gall-bladder disease may be aided by the daily evacuation of the viscus by the appropriate intake of fat, particularly the gall-bladder that empties slowly and incompletely but without symptoms. Such prophylaxis should be a part of antipartum care. Erhart treated with decholin several pregnant women with gall-bladder attacks. He thought that the attacks were brought out or increased by the pregnancy. The decholin was given in 10 cubic centimeter doses of a 20 per cent solution intravenously, three or four doses on successive days. He considered that the attacks were shortened and that the drug was useful. It did not in any way interfere with the pregnancy, and in one case he felt that sudden interruption of the pregnancy was avoided.

In the attempt to disinfect the biliary passages we encounter the difficulties inherent in all attempts at internal antisepsis. A drug that is even mildly effective may be entirely too toxic, especially for an injured organ. The German clinicians make use of combinations of bile salts with silver, like choleval. Lauda, in Vienna, has found trypaflavin the most potent agent, but recognizes its dangerous toxicity. Hurst, in England, employs large doses of methenamin (urotropin), giving similar doses of sodium bicarbonate at the same time to protect the kidneys. While the hepatic bile is alkaline, that of the gall-bladder is slightly acid and formalin is liberated there, but it is quite doubtful if its concentration is sufficient for the purpose. Takahashi, in a recent report, compares the effectiveness of mercurochrome, trypaflavin and flavicid on Bacillus coli and staphylococcus in experimental work on rabbits. He states that flavicid is excreted from the liver in greater concentration than the others, and inhibits markedly the multiplication of the bacteria mentioned in three hours. He suggests the employment of flavicid clinically in cases of infection of the bile ducts.

In summary, we may conclude that the admirable work of many investigators of the biliary system during the past decade furnishes the clinician with data for a greatly improved dietotherapy. The data for pharmacotherapy are not as rich, but there is evidence that we may supplement the dietetic hygienic regimen in many cases by the use of choleretics and of antispasmodics.

1035 North Calvert Street.

ANISEIKONIA* †

By K. C. BRANDENBURG, M.D.
Long Beach

DISCUSSION *by Julian N. Dow, M. D., Los Angeles; Otto Barkan, M. D., San Francisco; George N. Hosford, San Francisco.*

THOUGHTFUL ophthalmologists have long suspected that the conventional type of refraction does not reveal all of the defects which interfere with comfortable vision. The prevailing tendency is to attribute asthenopic symptoms, which persist after careful testing has brought the monocular visual acuity to its highest point, to extra-ocular muscle imbalance, or to difficulties in the patient's adjustment to his environment resulting in ocular neurosis. While this diagnosis is probably satisfactory in some cases, there remain a number of problems not so easily solved.

OCULAR NEUROSIS PROBLEMS

We have, for instance, the patient without gross heterophoria who is definitely less comfortable with his refractive error carefully corrected than with the poorer vision achieved by discarding his glasses. Most of you have shared my misgivings on having a disgruntled patient come from some colleague who does careful work, with the complaint that the glasses cannot be worn after a fair trial. The patient's faith in the benefits of science is somewhat shaken when, after a second examination, he is told that his glasses are all right; or when, worse yet, a minor change is made in the prescription leaving the condition unimproved.

* Read before the Eye, Ear, Nose, and Throat Section of the California Medical Association at the sixty-fourth annual session, Yosemite National Park, May 13 to 16, 1934.

† This paper, which you have been kind enough to allow me to present to you today, represents my impressions of this intensely interesting work on Aniseikonia, after a month's visit in the Department of Research in Physiological Optics in Dartmouth Medical School at Hanover, New Hampshire.

The entire credit for it must be given to Professor Ames and his group of collaborators, including Doctor Bielschowsky, through whose help and courtesy I am enabled to render you this report.—K. C. B.

There is also that most embarrassing of all situations, the patient with definite asthenopia, sometimes of an incapacitating nature, who presents, on careful examination, no refractive error or extra-ocular muscle imbalance, and yet knows definitely that his symptoms are aggravated by use of his eyes and relieved by rest.

What one of us has any idea, after we have painstakingly brought the patient's visual acuity to its highest point and find no gross extra-ocular muscle imbalance, whether the patient will really be more comfortable with his glasses, or whether he will become another dissatisfied drifter, going from refractionist to refractionist, never receiving relief?

We are also faced by the painful fact that in our attempts to develop fusion as a part of the management of strabismus, the best results—which are none too good when checked immediately after more or less prolonged fusion training—are even less encouraging after the training has been discontinued for a period of time. Many patients revert to their previous status.

To those of you, who have given thought to this situation, the news that an additional defect of binocular vision has been discovered which can be measured and corrected, will be welcomed with interest.

BIELSCHOWSKY'S OPINION

Considerable skepticism always greets a deviation from well-beaten paths; and that you may not be misled by my enthusiasm, I will quote the recently published comment by an outstanding European ophthalmologist, Professor Bielschowsky of Breslau, who has spent a number of months at Dartmouth Medical School with Professor Ames and his associates, who are the pioneers in this new development. Says he: "The Department of Research in Physiological Optics at Dartmouth has discovered that the retinal images of an object very frequently are of a different size and shape in the two eyes.[1] This fact, hitherto unknown, is of great importance, from not only the physiological but the clinical point of view. It has been ascertained that eyestrain, headache and other troubles, in many cases are caused by differences in the size and shape of the retinal images, and can be relieved or at least mitigated by glasses correcting that difference.[2] To what extent this defect is responsible for other ocular disturbances, the origin of which is obscure, is a problem to which the Research Department is devoting itself at present."

AUTHOR'S OBSERVATIONS AT DARTMOUTH

It has been my privilege to meet and question patients at the Dartmouth Clinic recently, who were wearing iseikonic corrections. Many of them had suffered from eye symptoms incapacitating them wholly or partly for many years. Others had been unable to get glasses which rendered comfortable and prolonged use of the eyes possible. I was greatly impressed with the relief which many of them claimed. One cannot help feeling that when the details of this new technique become perfected and its benefits made more generally available, it will be of inestimable value in many cases where the origin and management of the disability has hitherto baffled us.

About one thousand patients are now wearing the new iseikonic lenses which correct differences in the size and shape of the retinal images. Some of the data on this work was published three years ago.[3] More has been reported and will soon be in the literature.

REPORT OF CASE

Without repeating what has already been published on this subject, I would like to call your attention to a case which illustrates the significance of this work in connection with the problem of strabismus.

This patient was presented by Doctor Bielschowsky before the New England Ophthalmological Society in January of this year at Boston, and the New York Academy of Medicine a month later. He illustrates the fundamental rôle played by aniseikonia in horror fusionis, which may be defined in simple terms as a condition in which the sensory-motor apparatus refuses to bring the visual axes into alignment upon a common point of fixation because of some defect which renders fusion difficult or impossible.

CASE 1.—The patient, a South American architect, age twenty-five, gave a history of a convergent strabismus at the age of seven, following the occlusion of one eye for a week after an injury to the head. Two years later he was given glasses and four years after, in 1922, both eyes were operated on. During the following eleven years the right eye was said to have been blind, although the patient was in excellent health, studying hard, and participating in many sports.

In November, 1933, the patient suddenly noticed diplopia, which was accompanied by severe frontal and occipital headaches and pains in the neck, as well as dizziness and attacks of bilateral blindness lasting from ten to fifteen minutes. He was no longer able to work, suffered from insomnia, and lost thirty-two pounds.

In April, 1934, he came to New York, where careful and repeated general and neurologic examinations revealed no pathology. Wassermann tests on the blood and spinal fluid were negative. Because of the diplopia the patient was subjected to further operative procedures, involving the right superior oblique and right internal and external recti muscles, which resulted in an approximate alignment of the visual axes. The diplopia persisted, however, and the patient was then referred to another excellent ophthalmologist for fusion training, which proved of no avail. At the iseikonic clinic in New York, it was found impossible to obtain accurate measurements because of the diplopia.

The patient was then referred to the Department of Research in Physiological Optics at Dartmouth Medical School, where an exhaustive preliminary examination was made by Doctor Bielschowsky, whose findings in brief were that the patient had good visual acuity in both eyes, which were almost parallel, but that fusion could not be produced by any means. There was a paresis, either congenital or postoperative, of a number of the extra-ocular muscles together, with spasms of the different groups of muscles causing the lateral, vertical, and torsional components of an anomalous position of the eyes. These spasms produced intermittent and inconsistent variations in the alignment of the visual axes in the different fields of binocular fixation. The double images could be made to touch, or partly overlap, by means of prisms or the haploscope; but numerous and varied attempts to produce fusion failed. Because the patient had

squinted from childhood and diplopia had arisen only after the angle of squint had been considerably reduced, this seemed to be a typical case of horror fusionis.

Doctor Bielschowsky admitted that he could suggest nothing but a + 8.00 sphere before the left eye to blur the vision, and a 12-degree prism base in before the right eye to separate the double images. This relieved the diplopia, but not the headaches.

The case was then turned over to Professor Ames and his associates who, after several weeks of persistent effort, involving a study of the effect of various size lenses on the anomalous tilting of the head, finally succeeded in fitting the patient with a major size correction which gave him, for the first time in his life, comfortable binocular vision with depth perception. This correction completely eliminated the habitual head tilting, and gave him a certain amount of fusion amplitude, which increased after the glasses had been worn for a period. After four months he reports that he still has complete relief. When the glasses are removed, however, the diplopia and other symptoms recur, and one can observe the same inconsistent and irregular spasms of the eyes preventing alignment of the visual axes which Doctor Bielschowsky demonstrated when he presented the patient at the two meetings previously mentioned.

COMMENTS ON THE CASE

In commenting on the significance of this case, Doctor Bielschowsky states that henceforth, in every case of weak or defective fusion, we shall be forced to look for aniseikonia as a possible cause of the condition. Aniseikonia seems to be an important etiological factor, not only because it may cause an inferiority of the retinal images and the visual acuity in one eye, but because it may produce a disturbance of the normal fusion innervation of the eyes in an effort to prevent the superposition of incompatible retinal images.

What is the importance of this case in an understanding of the problem of strabismus?

THE FUSION PROBLEM IN NONPARALYTIC STRABISMUS

The inadequate development of fusion is the one outstanding characteristic shared in common by all types of nonparalytic strabismus. If adequate fusion is present, large differences in the refractive condition of the two eyes and the effort necessary to overcome large heterophorias or tropias may give rise to no symptoms, as we have frequently observed.

When fusion is difficult or impossible, due to aniseikonia or any other similarly interfering factor, the patient may seek adaptation by one of several means.

First: He may, in order to avoid diplopia or discomfort and confusion, develop the central scotoma in one macular region which we know as an amblyopia ex anopsia, as well as the anomalous retinal correspondence which we sometimes erroneously term a false macula.

Second: Reflex innervation of the extra-ocular muscles, in an attempt to avoid those same difficulties, may result in an habitual deviation of the visual axes from parallelism, as we observe in all nonparetic strabismus.

Third: By a modification of the first two methods, the patient may fix with either eye, while the other eye deviates and displays that transitory functional amblyopia called suppression. This is the condition observed in cases of alternating strabismus.

Many of the hitherto obscure and puzzling functional anomalies of the innervation of the extra-ocular muscles may be readily understood as being a physiological attempt at adaptation to a situation in which fusion is impossible or accomplished only at the expense of comfort. The expectation that these conditions will subside when equalization of the size and shape of the images makes fusion possible, seems to be borne out as the work on aniseikonia progresses.

A NEW CLINICAL CLASSIFICATION FOR THE MANAGEMENT OF STRABISMUS

If you will grant me the perilous prerogative of prophecy, I will venture to outline a new clinical classification for the management of strabismus:

In the first group are those cases with an irremediable anomalous retinal correspondence, which may be improved cosmetically by surgery if the amblyopia in one eye is sufficient to eliminate the risk of annoying diplopia.

In the second group we may place those cases with a normal retinal correspondence and sufficient visual acuity in both eyes, in which it may be possible, by means of surgical alignment of the visual axes, rendering the determination and correction of aniseikonia practical, to restore normal fusion with depth perception, thus attaining a perfect result.

In the third group will be cases without aniseikonia or an anomalous retinal correspondence where alignment of the visual axes, by surgery alone, results in fusion with depth perception. These cases might equally well respond to fusion-training with some such device as the haploscope, but where a gross heterophoria or tropia exists, the adjustment of the extra-ocular muscle balance, if it can be done judiciously and without interfering with the function of convergence, may be simpler and easier. This group should benefit by fusion-training following operation, although if no aniseikonia or similarly acting defect exists there is reason to believe that fusion with depth perception will develop spontaneously.

In the fourth group are those cases in which the correction of aniseikonia alone enabling adequate fusion to develop will suffice to maintain parallelism of the visual axes. Horror fusionis, and alternating strabismus with a small angle of deviation, may fall under this classification.

ANISEIKONIA AN IMPORTANT DISCOVERY

From the foregoing I believe you will agree with me that the discovery of aniseikonia gives us a key with which we may open the door to a better understanding of the management of nonparalytic strabismus.

Less interesting perhaps from the standpoint of the ophthalmologist, but more important to the numerous patients suffering from the less spectacular but frequently incapacitating symptoms of aniseikonia, in its minor degrees, are the refraction problems to which I called your atten-

tion at the beginning of this paper. I will not take your time repeating what can be learned from the literature already available, and soon to appear. A few general facts will suffice. It is estimated, on the basis of the data available, that about 20 per cent of all patients fitted with glasses could be further benefited by the correction of aniseikonia. This same data shows that about three out of four patients get either complete or partial relief from their symptoms, the most outstanding of which appear to be headache, photophobia, and suppression.

Aniseikonia may be present in the absence of other refractive error, or it may be produced by an anisometropic correction in which, plus power, tends to increase the size of the retinal image, and minus power to decrease it. Flat prisms used in an attempt to remedy heterophorias may produce aniseikonia, occasioning greater trouble than the heterophoria itself. The difference in the images is quite frequently independent of the dioptric correction and may even be opposite to that produced by the correction of anisometropia.

It is my impression that fusion amplitude, apparently dependent upon size amplitude, may prove to be a more important index of the probability of comfortable and adequate vision than the measurement of phorias upon which we have sought to render judgment in the past.

IN CONCLUSION

There is every indication that the discovery of aniseikonia marks a new era in the history of the alleviation of human suffering by scientific means. It will be well to acquaint ourselves with this new development, which is just in its infancy, and follow it with the interest it deserves lest we be left behind in the march of progress. Its implications, which are only now becoming apparent, must be revealed by further extensive clinical application and carefully-controlled research in which we, as ophthalmologists, should hasten to bear our part. Only a thorough knowledge of the unsolved problems which face us, and a willingness to inquire honestly concerning our failures, will prevent us from being laggard in the duty of offering to our patients the best that science has made available.

110 Pine Avenue.

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DISCUSSION

JULIAN N. DOW, M. D. (727 West Seventh Street, Los Angeles, California).—First, I take the liberty of reviewing a few facts regarding the differences of retinal images:

The average size difference in normal persons, free of symptoms, has been found to be 0.53 of 1 per cent. The average size difference in patients with symptoms has been found to be 1.53 per cent. Professor Ames has stated that the relative size and shape of the retinal images are subject to change, but it is not known what the physiological functions are which produce those changes. The wearing of a refractive correction produces a change in size of the image, a plus lens increasing and a minus lens decreasing. Again the amount varies with the base curve and the location of the lens. A plus one biconvex sphere in the trial case causes a difference in size of 2.3 per cent, and the same correction ground on a six base curve causes a difference of 3.3 per cent.

To measure aniseikonia, a special instrument to measure the ametropia as well as the aniseikonia has been designed.

The time necessary for completion of the examination is from one to four hours; the cost of the instrument and the cost of the correcting lens quite expensive. The correction is then worn in a majority of cases in the form of fit-overs and must be tried for a few days; then, perhaps, changes made, and tried again.

It has been estimated that 30 per cent of the wearers of glasses have aniseikonia, and that 80 per cent can be offered relief, but I cannot help but feel that these figures are very high, both as to the presence of the size difference and as to the relief that can be afforded.

A procedure that requires as complicated an instrument, and as intelligent and coöperative a patient, and that deals with as sensitive a subject as size differences of retinal images, must have in those cases of smaller percentages much greater percentages of error, and naturally a smaller amount of relief afforded.

From a practical standpoint, those of us practicing clinical ophthalmology could only expect coöperation from the patient whose suffering has been severe and whose patience very great; for undoubtedly, many changes would have to be made before his permanent correction could be found.

Then, as each change in the ametropic correction would be made from year to year, further exhaustive tests would have to be made to determine the amount of aniseikonia.

Surely this cannot be accomplished in the average office or clinic, unless some procedure less complicated than that employed at present is found.

Professor Ames and his coworkers, practicing as researchers, are accomplishing great results and, as Doctor Brandenburg has stated, will produce many changes in our refractive procedure and in our attitude to many phases of fusion; but I do not feel that, at the present time, we, as clinical ophthalmologists, can include thorough testing for aniseikonia in our refractive work.

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OTTO BARKAN, M. D. (490 Post Street, San Francisco).—I think it is much to Doctor Brandenburg's credit that he has been able to give to this section such a remarkably clear and simple picture of aniseikonia. I would like to elaborate on a few of the points Doctor Brandenburg has brought out, such as the changing of lateral phorias of as high as five prism degrees, and hyperphorias of one-half to one and one-half degrees to normal.

The lenses used to correct large differences of refractive errors in the two eyes create induced size differences. Thus, for instance, a $+ 3.00 + 1.75 \times 180$ on the right eye and an $+ 0.50 + 0.50 \times 180$ on the left eye theoretically induce approximately 6.22 per cent over all, and an addition of about 3.52 per cent in the ninetieth meridian in the right eye due to an extra magnification of the stronger lens. The patient who

has size amplitude, which is analogous to fusional amplitude, would be perfectly comfortable with this correction because he could compensate for the induced size. Another patient who is sensitive to size changes, or in using the fusion sense as a comparison, having weak fusion powers, low ductions, etc., would not be able to compensate for induced size and, consequently, would not be relieved of his asthenopic symptoms by the correction; the symptoms would, indeed, be increased in severity by the induced aniseikonia. In regard to the Velez case, it is important to note the increases in fusional amplitude while wearing the iseikonic correction. After wearing the iseikonic lenses for three days, it required but one prism degree to break fusion in abduction, two degree prism to break it in adduction. After two months it required approximately six degrees to break abduction, and ten degrees to break adduction. The vertical ductions had similarly increased. Doctor Bielschowsky has presented conclusive proof that this patient's remarkable relief of symptoms, double vision, etc., was not due to suggestion or psychotherapy.

Through the work of Doctor Ames and his group we are now in possession of a new factor in the primary causation of strabismus. Aniseikonia makes it impossible to maintain comfortable binocular vision. The eyes deviate from parallelism in the sense of a flight strabismus, suspension taking place and amblyopia ex anopsia following in the deviated eye.

There is another phase of this remarkable work which is being done by Doctor Ames and his group at Dartmouth, namely, that phase of the work which is in relation to cyclophoria. Cases of cyclophoria have up to the present often been missed or ignored. Past attempts to relieve by changing the axis of the cylinder or by reducing its amount, orthoptic training and surgery on the oblique muscles, have been more or less unsatisfactory.

The present eikonometer measures only aniseikonia at axis, 90 or 180 or over-all aniseikonia. In order to test for off-axis or meridional aniseikonia, Doctor Ames has perfected an instrument which he calls the tipping field, or tilting or flying field. It consists of two stippled ground glass plates giving an impression of depth. For the far tests, the plates are in the horizontal position; for the near tests, in the vertical. The subject is required to adjust them in what appears to be to him the perfect horizontal or vertical plane. From the position of the plates, declination or conclination can be diagnosed, vertical tilt designating the declination and horizontal the conclination. Tilting forward denotes the presence of incyclophoria, tilting backwards the presence of excyclophoria. By means of a scale these can be measured to a degree. By this means the off-axis of an aniseikonia can be measured and corrected. Doctor Ames and his coworkers found that cyclophoria produced such a tipping field abnormality; that it can be measured and be corrected by proper iseikonic lenses. Cyclophoria is corrected, or strain relieved when aniseikonia is present, by equalizing the image sizes in the proper meridian; or in the absence of aniseikonia an artificial aniseikonia is induced by iseikonic lenses with resultant reflex cyclophoria in the opposite direction of that present.

Many cases of hitherto uncorrectable fatigue for near work, poor depth perception (aviators making poor landings), photophobias of unknown origin and many so-called neurasthenic patients have been completely relieved by correcting the apparent cyclophoria in this way.

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GEORGE N. HOSFORD, M. D. (490 Post Street, San Francisco).—I am sure we all owe Doctor Brandenburg a debt of thanks for bringing to us a first-hand account of this new development in physiologic optics. I have but little patience with the criticisms leveled at this amazing piece of work, particularly when they emanate from those who have not studied it. The discoveries of Dr. Frank W. Weymouth and his collaborators on retinal grain may prove to be the anatomic basis on which it rests. It may well be the unknown factor in both the etiology and treatment of strabismus for which investigators have been looking in vain for so many years.

We should have predicted some such development to account for some of the unexplained phenomena in ophthalmology, just as astronomers have predicted the presence of a new planet from mathematical calculations made before the planet was ever seen through the telescope. The discovery of aniseikonia, and of a method of correcting it with lenses, may well give us another means of dealing with squint, which may be even more important than anything yet applied to the problem.

MODERN TRENDS IN ANESTHESIA*

By RALPH M. TOVELL, M.D.
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ALMOST a century has elapsed since the discovery of anesthetic agents and their application in clinical practice. Prior to this time the successful surgeon was usually a young man of iron nerve, who was capable of undertaking rapid but merciless operative procedures. Anesthesia opened wide vistas for successful surgical research and achievement. The surgeon no longer has to be young, daring, and ruthless; he still must have nimble and dextrous hands, but the guiding brain may be a mature one, which is influenced by a wealth of experience. Anesthesia has made possible, in great degree, the remarkable development in surgery. Patients have come to expect relief of pain during surgical procedures, and they are becoming more and more insistent that pain be relieved in medical and obstetric practice as well.

ANESTHETIC AGENTS IN OBSTETRICS

Chloroform.—Chloroform has retained, in many localities, its popularity as an anesthetic agent that is capable of relieving, to a great extent, the pain that is encountered in the process of childbirth. This drug has been favored over ether because of its greater power to produce analgesia. The present trend is to eliminate the use of both these agents during labor. Patients are demanding, and obstetricians are putting greater stress on, the relief of pain that is encountered early in labor. It has become quite a general custom to administer a derivative of barbituric acid in repeated small doses by mouth, for example, pentobarbital sodium, three grains (0.20 gram) when dilatation of the cervix has reached two centimeters. This dose may be repeated as it seems advisable. Care must be exercised in order to avoid the occurrence of undue restlessness. The total dose of the barbiturate may be kept minimal if morphin is administered in conjunction with it. Morphin, grain one-sixth, is frequently found beneficial, but its administration must be limited to the early hours of labor;[7] otherwise the baby may be cyanotic and apneic at birth.

Barbiturates.—The barbiturates find their most effective application when they are administered intravenously to patients exhibiting convulsive seizures of eclampsia. The convulsions may be

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* From the Section on Anesthesia, The Mayo Clinic, Rochester, Minnesota.

Read before the Anesthesiology Section of the California Medical Association at the sixty-fourth annual session, Yosemite National Park, May 13 to 16, 1935.